

NASA TECH BRIEF



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100 Å Niobium Wire

The size and proximity effects of a superconductor in a normal matrix has been investigated. A composite of fine niobium wires in copper was chosen for its desirable mechanical and chemical properties and a fabrication technique was developed from the method of Levi.

The starting materials were 1/8-inch diameter electron-beam melted Nb rod, and OHFC copper tubing with 0.375-inch od and 0.032-inch wall thickness. The tubing was swaged onto the rod and the ensemble then drawn to 0.0345-inch diameter wire which was cut into 56 pieces. These pieces were fitted into another piece of copper tube, and the ensemble drawn down again to 0.0345-inch diameter. This procedure was repeated four times, and on the final sequence, the wire was drawn down to 0.006-inch diameter, which, on the assumption of uniform straining of the Nb and Cu, corresponds to a Nb diameter of about 100 Angstroms. Before assembling each composite prior to a drawing sequence, the surfaces of the wires and tube were carefully cleaned, degreased with a solvent (trichloroethylene) and abraded with No. 600 metallographic paper and recleaned. Drawing was done at the uniform rate of one inch per minute by mounting dies and wire in an Instron tensile testing machine. Commercial wire-drawing equipment was found to be insufficient even in its drawing rate, and all attempts to make composites using commercial equipment in the laboratory failed. The low draw-

ing rate was also necessary. The lubricant used was of the MoS₂ type.

At various stages in the fabrication, specimens were secured for optical electron micrography and diffraction. For the second and third sequences, optical metallography with routine diamond-dust polishing and no etching sufficed to delineate the structure. For subsequent operations, electron micrography was necessary. The Cu matrix was removed by etching with 50% HNO₃, the resulting niobium "wool" was washed, broken up by ultrasonic cavitation, and removed from the water with a standard grid used for transmission electron micrography.

Note:

Inquiries concerning this innovation may be directed to:

Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
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Patent status:

No patent action is contemplated by NASA.

Source: H. E. Cline, R. M. Rose,
and J. Wulff
of Massachusetts Institute of Technology
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